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(71) Applicant *(for all designated States except US)*: TA-PLAST SPA [IT/IT]; S.S. Marosticana, 65/67, I-36031 Dueville (IT).

(71) Applicants and
(72) Inventors *(for CA, US only)*: SANTAGIULIANA, Stefano [IT/IT]; Via Ponte Marchese, 80, I-36030 Caldogno (IT). IANNASCOLI, Franco [IT/IT]; Via Arrigo Boito, 80, I-36100 Vicenza (IT). LOBBA, Paolo [IT/IT]; Via della Resistenza, 42, I-36063 Marostica (IT).

(74) Agent: BONINI, Ercole; Studio Ing. E. Bonini SRL, Corso Fogazzaro, 8, I-36100 Vicenza (IT).

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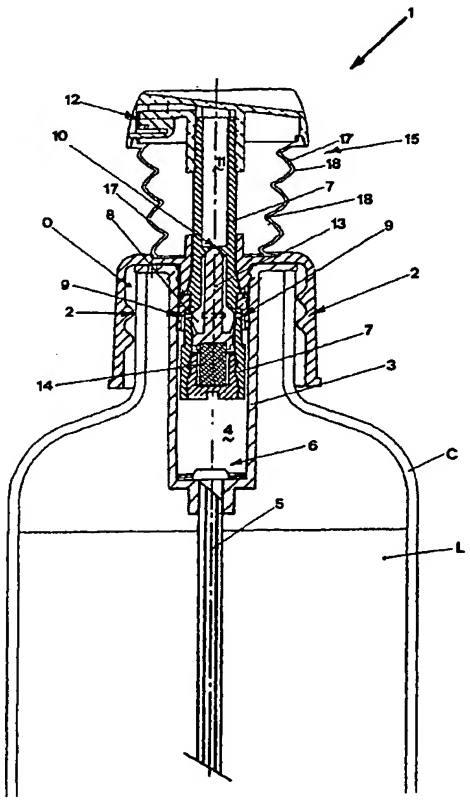
(54) Title: NEBULIZER FOR LIQUIDS



(57) Abstract: Nebulizer (1, 100, 101) for liquids applicable to the neck (O) of a recipient (C) that contains the liquid (L) to be delivered including a hollow body (3), that at the top consists of a compression chamber (4), a suction duct (5) for the liquid communicating with the compression chamber (4), valves (6) designed to close/open the suction duct (5), the first sealed piston (9) coupled in a sliding configuration to said hollow body (3) with a tubular chamber (8) that communicates with the compression chamber (4) and with a delivery channel (11) for the liquid (L), a stopper plug (13) that moves in a contrasting manner with the first set of elastic means (14) to close/open a choke (10) and the second set of elastic means (15) installed between the hollow body (3) and the sealed piston (7). The first set of elastic means (14) is made with non-metallic materials.

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IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

NEBULIZER FOR LIQUIDS

The invention refers to a nebulizer for liquids, perfumes and similar products, particularly suitable for temporary application to recipients containing the liquid to be delivered.

As known, liquids, and in particular perfumes and similar products, can be nebulized by increasing the pressure of the liquid to be delivered by passing it through a nozzle equipped with holes gauged in relation to the density of the liquid to be delivered and the degree of nebulization to be obtained.

To do this, special devices, called "nebulizers", are used which are temporarily applied to the recipients containing the liquid to be nebulized and are activated manually by the user.

These nebulizers generally include a hollow body with a compression chamber for the liquid communicating with a suction duct inserted in said liquid, whose opening/closing is controlled by means of valves. A sealed piston in a sliding configuration coupled to the hollow body that moves in a contrasting manner with the elastic means, compresses and sucks the liquid contained in the compression chamber.

Internally, the sealed piston is equipped with a tubular chamber that communicates on one side with the compression chamber and on the other, through a choke, with a delivery duct for the liquid equipped with a nozzle.

A stopper plug, sliding elastically inside the tubular chamber, opens/closes the choke and allows the liquid to flow.

From an operative viewpoint, the user, by activating the piston, closes the valves, loads the elastic means and compresses the liquid contained in the compression chamber, gradually increasing its pressure.

The pressure is discharged on the stopper plug until the choke opens, allowing the pressurised liquid to reach the nozzle.

After completing the delivery operation, the elastic means returns the piston to the initial position, generating a vacuum within the compression chamber, opening the valves and sucking the liquid, preparing the nebulizer for the next delivery operation.

The main problem with the nebulizers as described is that the elastic means used to make the movement of the sealed piston and the stopper plug smoother, consists of metallic helical springs. This makes it difficult to recycle the nebulizer because the metallic parts must first be separated from the

plastic parts.

The need for such a separation significantly increases the cost of the entire recycling process and sometimes making it economically unfeasible.

On the other hand, replacing the metallic springs with various types of elastic, non-metallic materials creates some problems since, as known, metallic springs have a response curve that is almost linear, as illustrated in fig. 1, while similar elastic non-metallic elements have a non-linear and asymmetrical response curve, as shown in fig. 2.

Furthermore, such elastic elements have a compression curve R that is different from the expansion curve D, thus significantly increasing the complexity in creating elements with characteristics that are similar to those of the metallic helical springs.

In particular, to obtain an elastic force with the required intensity D during the expansion phase, the user must generate a greater force R during the compression phase.

The purpose of this invention is to solve the aforementioned problems.

In particular, the purpose of this invention is to build an all-plastic nebulizer.

The previously mentioned purposes can be achieved by a nebulizer for liquids equipped with devices to be coupled to the neck of a recipient containing the liquid to be delivered, that in accordance with the main claim includes:

- at least one hollow body, that at the top consists of a compression chamber for said liquid;
- at least one suction duct for said liquid at least partially immersed in said liquid, communicating with said compression chamber;
- valves installed downstream from said liquid suction duct to close/open said suction duct;
- a first sealed piston coupled in a sliding configuration to said hollow body, equipped internally with a tubular chamber that communicates through a communication duct with said compression chamber and by means of a choke with a liquid delivery channel, and said delivery channel being equipped with a nozzle to nebulize said pressurised liquid;
- a stopper plug sliding inside said tubular chamber that moves in a contrasting manner with the elastic means to close/open said choke;
- a second set of elastic means installed between said hollow body and said sealed piston;

for which the first set of elastic means is built with non-metallic material.

The advantage of this invention is that it reduces the number of elements comprising the nebulizer with respect to the known types.

Another advantage of the invention is that it improves the nebulization of the liquid with respect to the known types of nebulizers.

The aforementioned purposes and advantages will be highlighted in greater detail in the description of a preferred version provided as a non-limiting example and represented in the drawings where:

- fig. 1 represents a Cartesian diagram of the compression/force generated by a known type of metallic helical spring;
- fig. 2 represents the elastic response of an elastic element similar to the element shown in fig. 1, built with an elastomer material;
- fig. 3 represents a partial cross-section of a nebulizer, the subject of this invention, applied to a recipient;
- figs. 4 and 5 represent executive arrangements of an item of the nebulizer shown in fig. 3;
- fig. 6 represents a layout of an element comprising the nebulizer shown in fig. 1;
- fig. 7 represents a cross-section of the element shown in fig. 6;
- fig. 8 represents the nebulizer shown in fig. 3 during an operating phase;
- fig. 9 represents the nebulizer shown in fig. 3 during another operating phase;
- fig. 10 represents the nebulizer shown in fig. 3 during a subsequent operating phase;
- fig. 11 represents an arrangement of the nebulizer shown in fig. 3;
- figs. 12 and 13 represent a cross-section of the operating phases of the nebulizer shown in fig. 10;
- fig. 14 represents an executive arrangement of the nebulizer shown in fig 10.

The nebulizer described in this invention, particularly suitable for perfumes and similar products, is represented in fig. 3 where it is indicated overall with 1 at neck O of a recipient C containing a liquid L to be delivered and includes a hollow body 3 that at the top consists of a liquid compression chamber 4 which communicates with the interior of the recipient C, through a suction duct 5 immersed in the liquid L.

Valves, indicated overall with 6, are installed downstream of the suction duct 5 and are used to open/close it during the various operating phases of the nebulizer 1.

The first sealed piston 7 is coupled in a sliding configuration to the hollow body 3 and is equipped internally with a tubular chamber 8 which, through a passage way 9, communicates with the compression chamber 4 and by means of a choke 10, communicates with a delivery channel 11 for the liquid L with a nozzle 12 to nebulize said liquid L.

A stopper plug 13 is coupled in a sliding configuration to the interior of the tubular chamber 8 and moves in a contrasting manner with the first set of elastic means 14 to open/close the choke 10.

A second set of elastic means 15 installed between the hollow body 3 and the sealed piston 7 is loaded during the liquid L compression phase and, once delivery has been completed, allows the sealed piston 7 to return to the resting position with an elastic movement.

According to this invention, the first set of elastic means 14 must be built with non-metallic elastic materials, for instance elastomers, such as thermoplastic rubber.

It is important to note that, thanks to the geometry of the elastic element, different elastic responses can be obtained. In fact, it basically has a cylindrical shape but, based on another executive arrangement, can also be spherical 14a, as shown in figs. 4 and 5.

In particular in the executive arrangement shown in fig. 5, a spherical elastomer element 14a is shown which is placed in contact with the sealed piston 7 by means of a projection 16 for which a sudden elastic yield can be obtained at the critical force. As a consequence, there is an almost step-like elastic response.

In fact, the points of contact between the elastomer 14a and the tubular chamber 7, combined with the geometric shape of the elastomer, help to determine the development of the elastic response curve.

For what concerns the second set of elastic means 15, it consists of a compression spring 17 made with plastic material having, in the preferred version, a truncated conic shape but that, according to additional shapes, can also be, for example, cylindrical.

Finally, it should be noted that the perimeter of the compression spring 17 has

a spiral ribbing 18 that guarantees the necessary elastic performances at said spring.

For what concerns the valves 6, they include a valve element installed near the bottom of the compression chamber 4, represented in detail in figs. 6 and 7, designed to close/open the suction duct 5 of the liquid L.

It consists substantially of a main flat body 20 that on the exterior has projecting elastic spokes 21 that are coplanar to it in what is basically a spiral shape.

From an operative viewpoint, the user loads the compression spring 17, as shown in fig. 8, by exerting pressure P on the first sealed piston 7 and pushes the main body 20 against the walls of the compression chamber 4. The main body 20 closes the suction duct 5, allowing the piston 7 to compress the liquid L inside the compression chamber 4.

The pressure, increasing gradually, is discharged through the communication duct 9 on the stopper plug 13 that, in turn, compresses the elastomer 14.

When the pressure of the liquid L inside the compression chamber 4 exerts a force on the stopper plug that is slightly greater than the critical force, the elastomer 14 contracts and the stopper plug 13 slides vertically toward the bottom, opening the choke 10 and thus allowing the pressurised liquid L to reach the nozzle 12, as can be seen in the detail shown in fig. 8.

After the first sealed piston 7 reaches the bottom of the compression chamber 4, as can be seen in fig. 9, it is released by the user, thus terminating the delivery phase.

Once delivery has been completed, as shown in detail in fig. 10, the compression spring 17 returns the sealed piston 7 to its initial position, generating a vacuum inside the compression chamber 4.

This vacuum lifts the main body 20 and opens the suction duct 5, allowing the liquid L to flow within the compression chamber 4 and preparing the nebulizer 1 for the next delivery operation.

Tests performed have indicated that the elastic response of the elastomer element 14, as previously mentioned, is very close to the step and thus the choke 10 opens and closes rapidly and allows nebulizer 1 operation to approach the ideal operating condition.

An executive arrangement of the nebulizer that is the subject of the invention indicated with 100 is shown in detail in fig. 11 and differs from the pervious one

owing to the different construction of the valves 6 designed to open/close the suction duct 5 for the liquid L.

In particular, such valves 6 consist of a second sealed piston 23 that is solidly joined to the first sealed piston 7, coupled in a sliding configuration to a suction chamber 22 built along the extension of the compression chamber 4, installed between the latter and the suction duct 5 for the liquid L.

Figures 12 and 13 demonstrate the similar operating phases of the executive arrangement of the nebulizer of fig. 11.

Another executive arrangement, represented in fig. 14, and indicated overall with 101, shows how the suction duct 5 for the liquid L can be closed during the compression phase by using a diaphragm 24 that adhering to the stem 25 of the second sealed piston 23, guarantees the seal necessary for compression and suction of the liquid L.

Any invention described with reference to the attached figures may be subject to constructive changes that fall within the claims and thus is protected by this patent.

CLAIMS

1) Nebulizer (1, 100, 101) for liquids equipped with devices for coupling (2) to the neck (O) of a recipient (C) that contains said liquid (L) to be delivered, including:

- at least one hollow body (3), that at the top consists of a compression chamber (4) for said liquid (L);
- at least one suction duct (5) for said liquid at least partially immersed in said liquid (L), communicating with said compression chamber (4);
- valves (6) installed downstream of said suction duct (5) for the liquid (L) to close/open said suction duct (5);
- a first sealed piston (9) coupled in a sliding configuration to said hollow body (3), equipped internally with a tubular chamber (8) that communicates through a communication duct (9) with said compression chamber (4) and by means of a choke (10) with a delivery channel (11) for the liquid (L), and said delivery channel (11) being equipped with a nozzle (12) to nebulize said pressurised liquid (L) ;
- a stopper plug (13) sliding inside said tubular chamber (8) that moves in a contrasting manner with the first set of elastic means (14) to close/open said choke (10);
- a second set of elastic means (15) installed between said hollow body(3) and said sealed piston (7);

characterised by the fact that said first set of elastic means (14) is built with non-metallic materials.

2) Nebulizer (1, 100, 101) according to claim 1) **characterised by the fact** that said non-metallic materials are elastomers.

3) Nebulizer (1, 100, 101) according to claim 1) **characterised by the fact** that said elastic means (15) consist of a compression spring (17) made with plastic material.

4) Nebulizer (1, 100, 101) according to claim 3) **characterised by the fact** that said compression spring (17) has a truncated conic shape.

5) Nebulizer (1, 100, 101) according to claim 3) **characterised by the fact** that said compression spring (17) has a cylindrical shape.

6) Nebulizer (1, 100, 101) according to claim 3) or 4) or 4) **characterised by the fact** that said compression spring (17) has at least one spiral ribbing (18) along the perimeter.

7) Nebulizer (1) according to claim 1) **characterised by the fact** that said valves (6) include a valve element installed in proximity to the bottom of said compression chamber (4) and designed to close said suction duct (5) for the liquid (L).

8) Nebulizer (1) according to claim 7) **characterised by the fact** that said valve element includes what is substantially a main flat body (20) equipped with projecting elastic spokes (21) which substantially are coplanar to it.

9) Nebulizer (1) according to claim 8) **characterised by the fact** that said elastic spokes (21) have a spiral shape.

10) Nebulizer (100, 101) according to claim 1) **characterised by the fact** that said hollow body (3) consists at the bottom of a suction chamber (22) built along the extension of said compression chamber (4), installed between the latter and said suction duct (5) for the liquid (L).

11) Nebulizer (100, 101) according to claim 10) **characterised by the fact** that said valves (6) consist of a second sealed piston (23) coupled in a sliding configuration to said suction chamber (22) and solidly joined to said first sealed piston (7).

12) Nebulizer (101) according to claim 11) **characterised by the fact** that said valves (6) consist of a diaphragm (24) solidly joined to the compression chamber (4) that adheres to the stem (25) of a second sealed piston (23) coupled in a sliding configuration to said suction chamber (22) solidly joined to said first sealed piston (7) when said nebulizer (1) is activated.

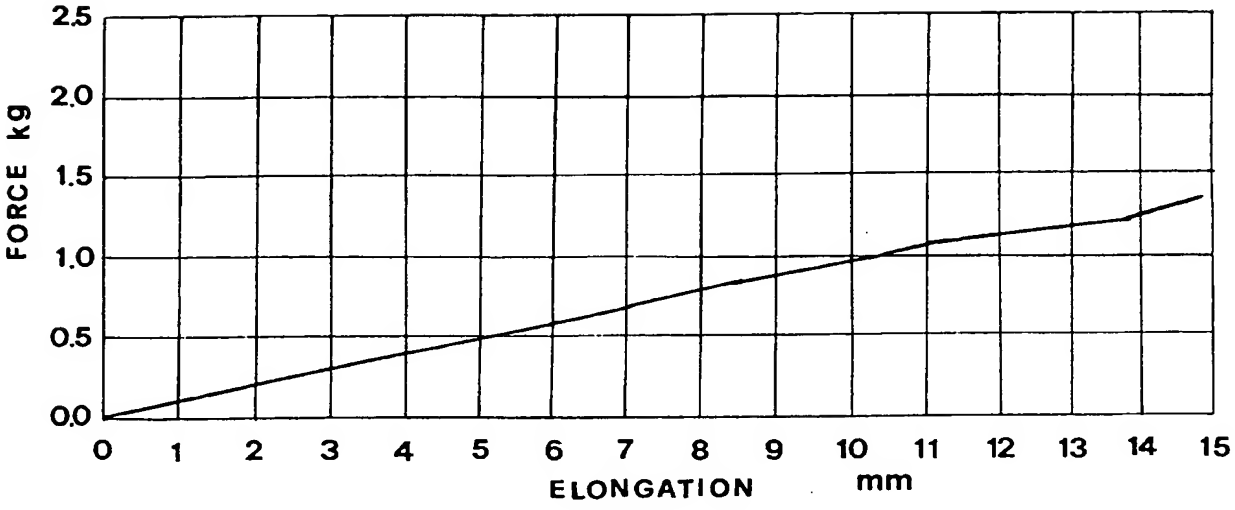
FORCE kg
2.5
2.0
1.5
1.0
0.5
0.0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
ELONGATION mm

FIG.1

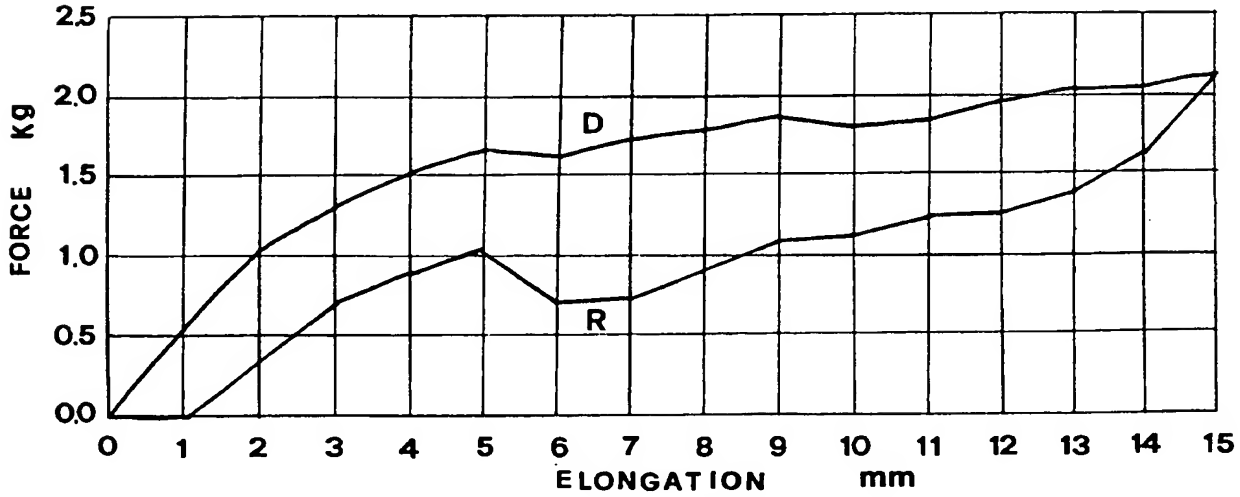
FORCE kg
2.5
2.0
1.5
1.0
0.5
0.0
D
R
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
ELONGATION mm

FIG.2

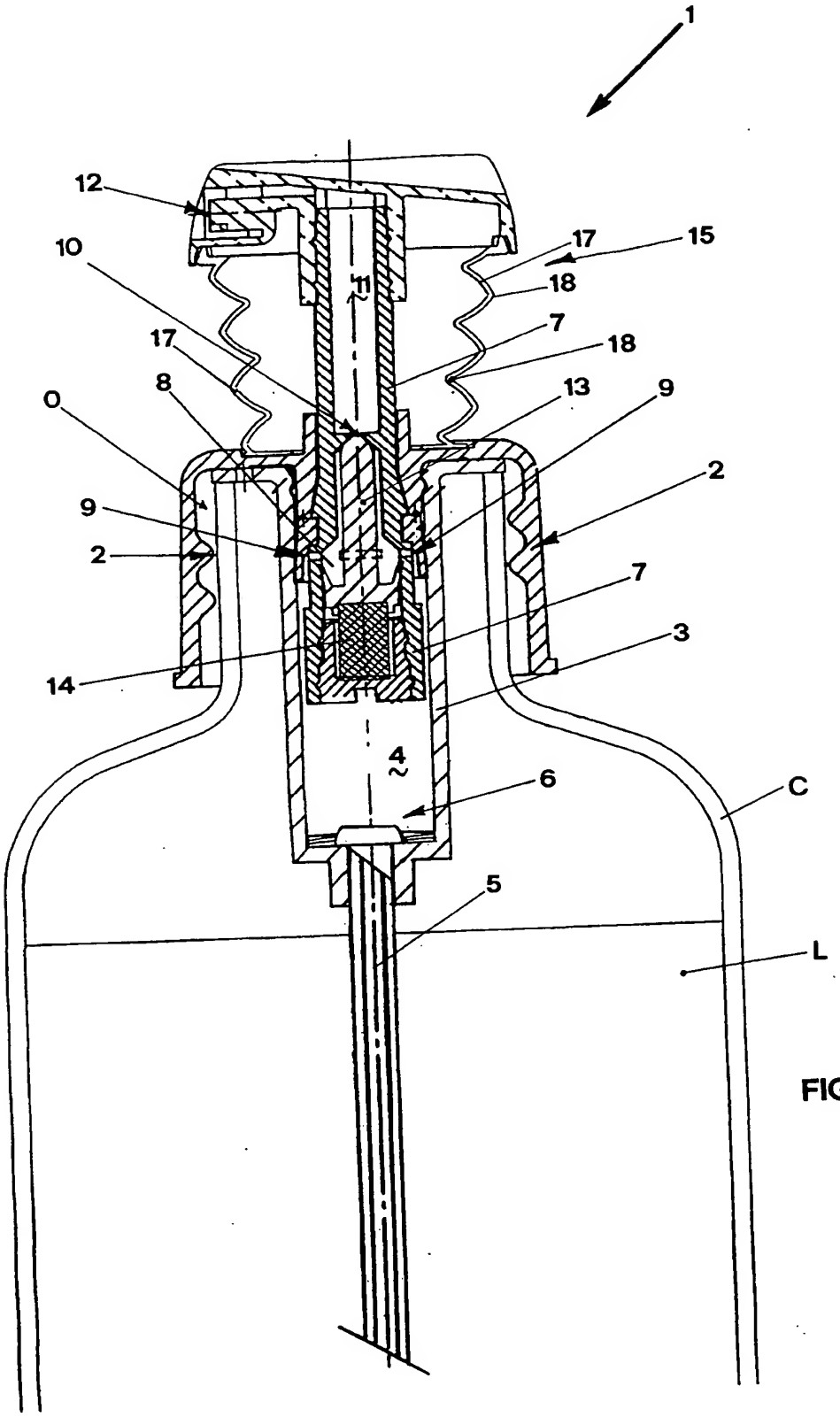

FIG.3

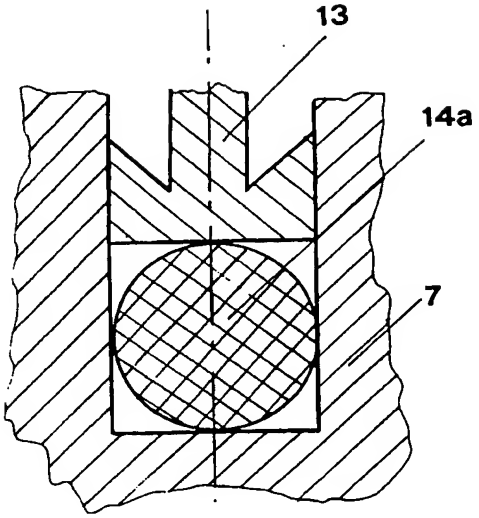

FIG.4

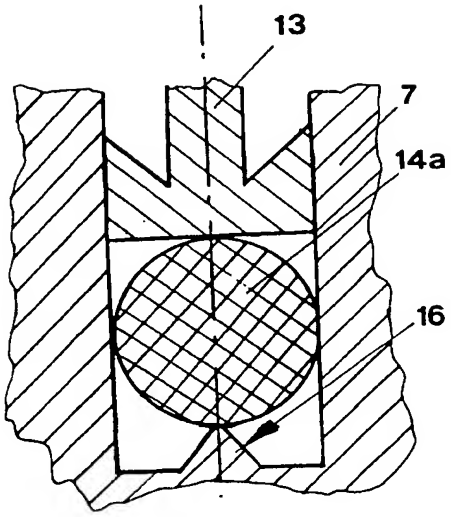

FIG.5

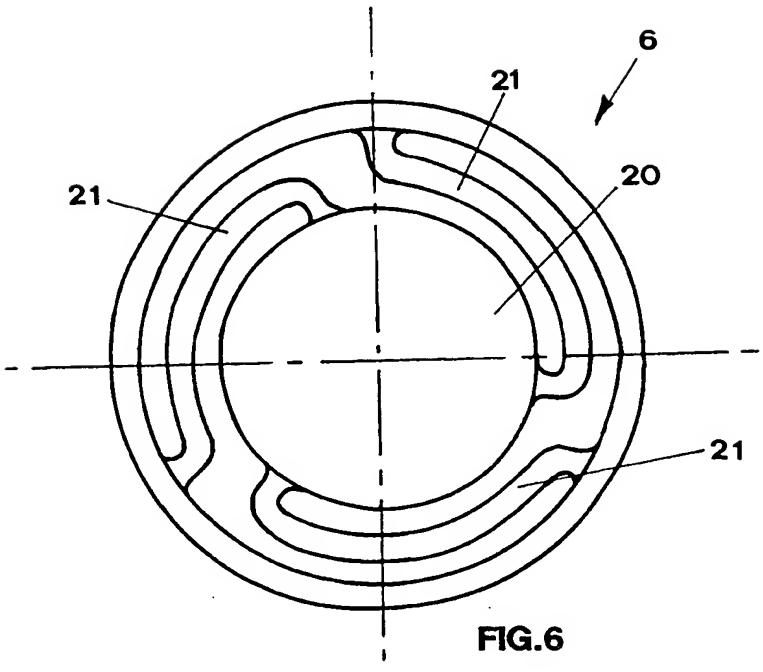

FIG.6

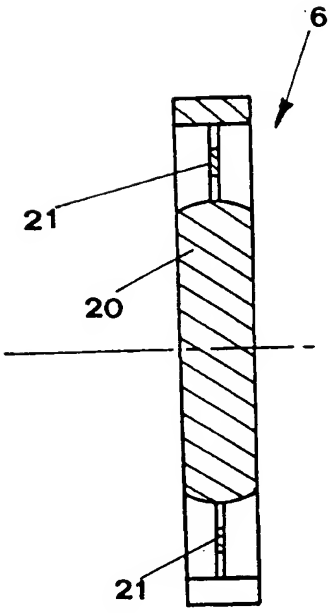

FIG.7

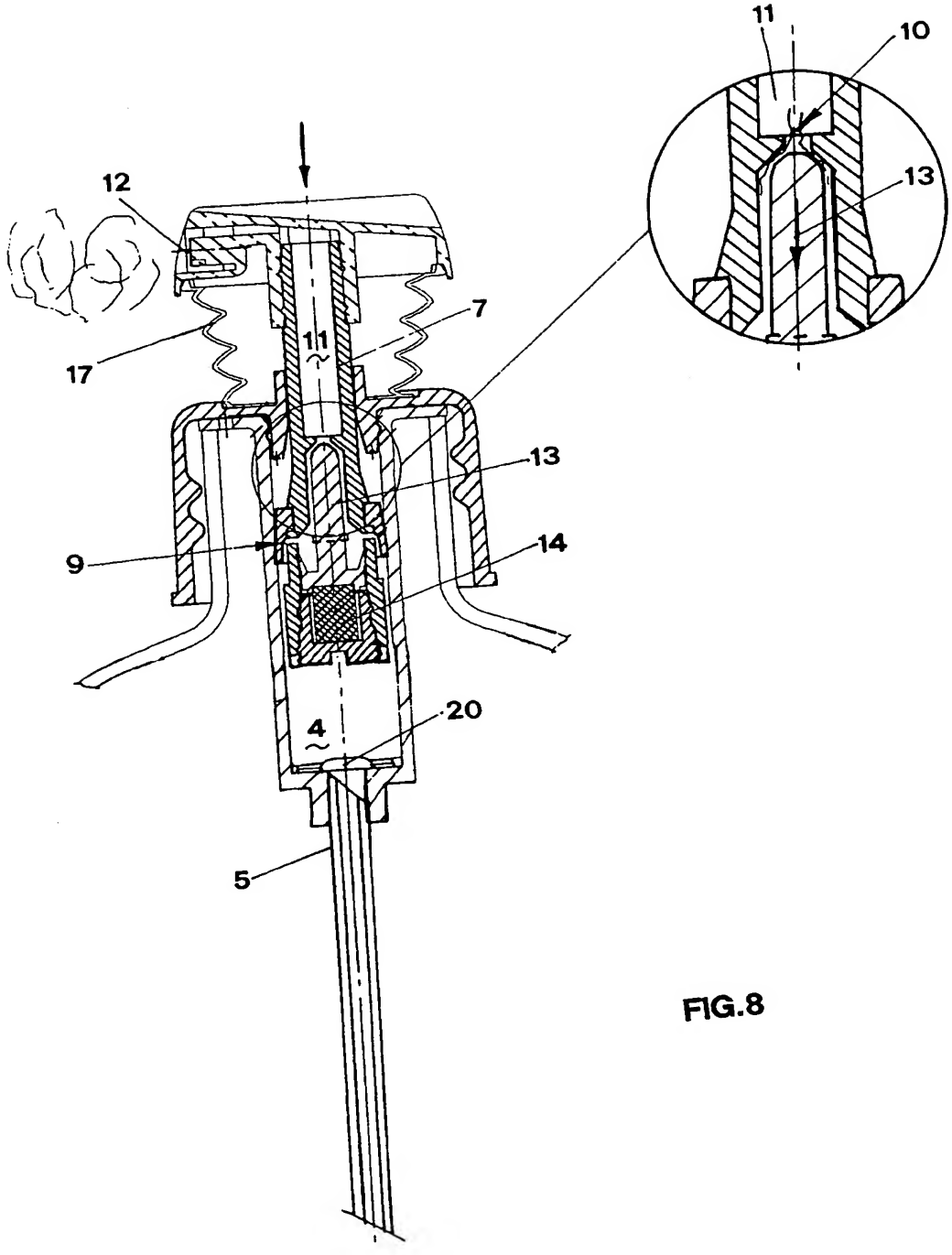

FIG.8

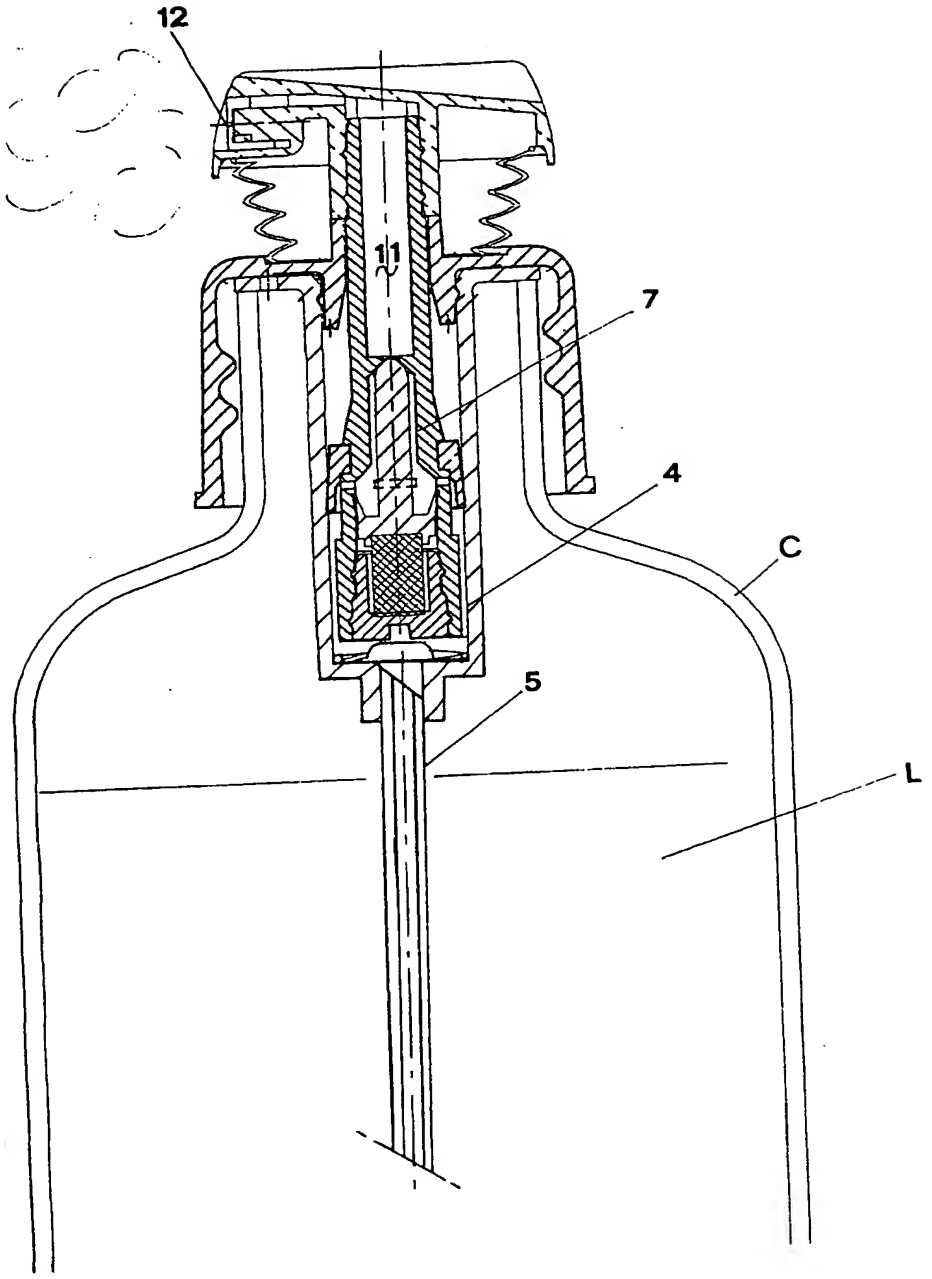

FIG.9

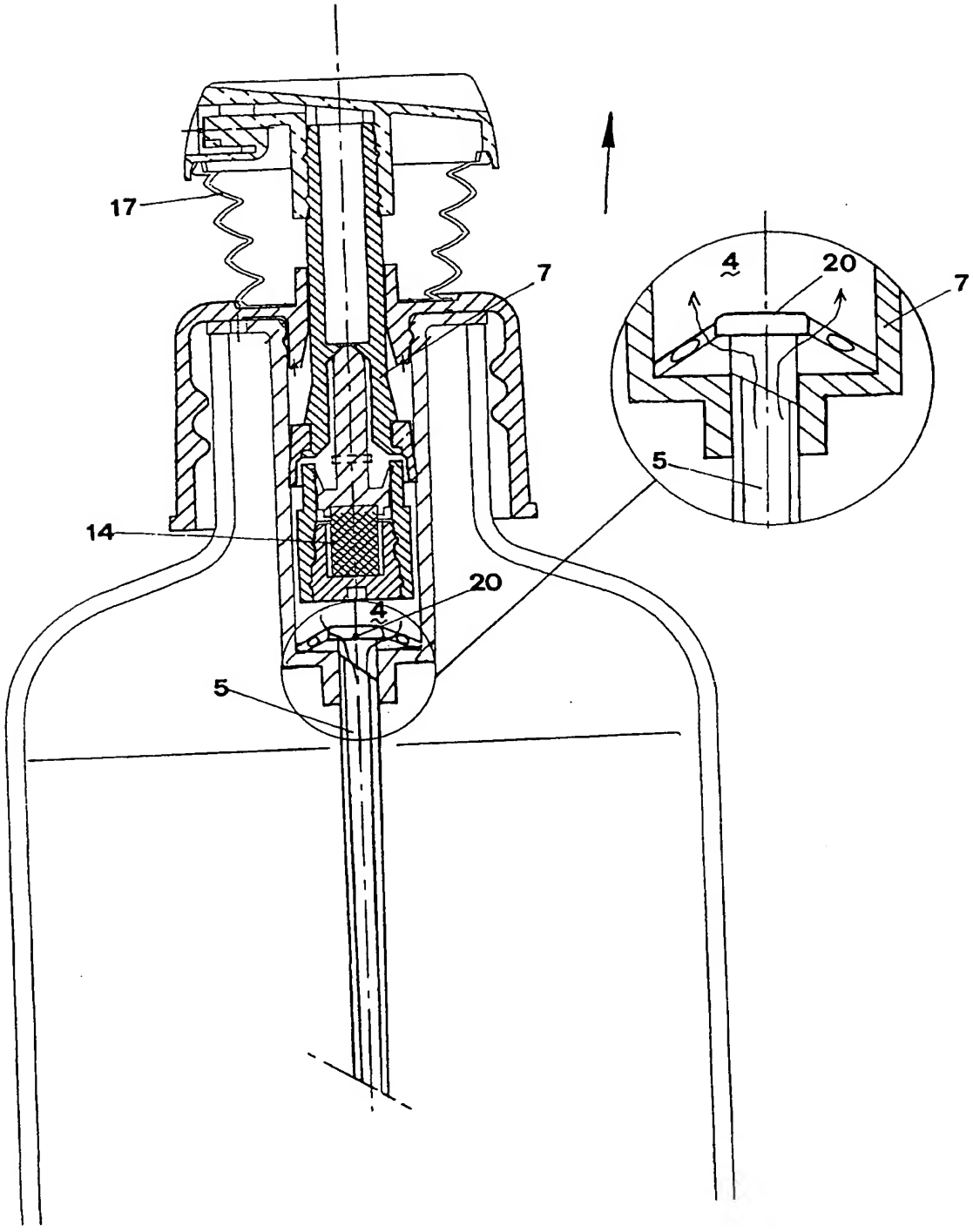

FIG.10

7/10

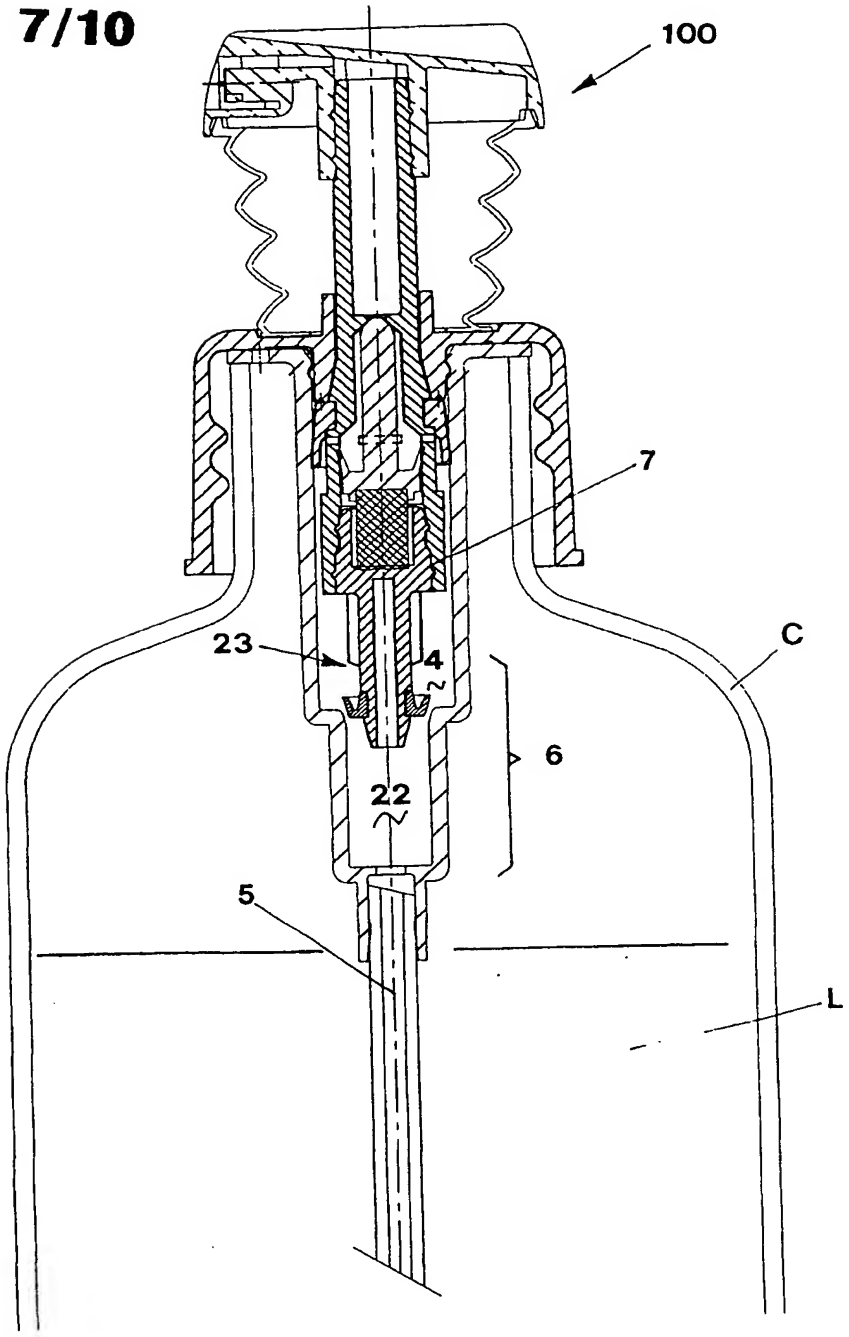

FIG.11

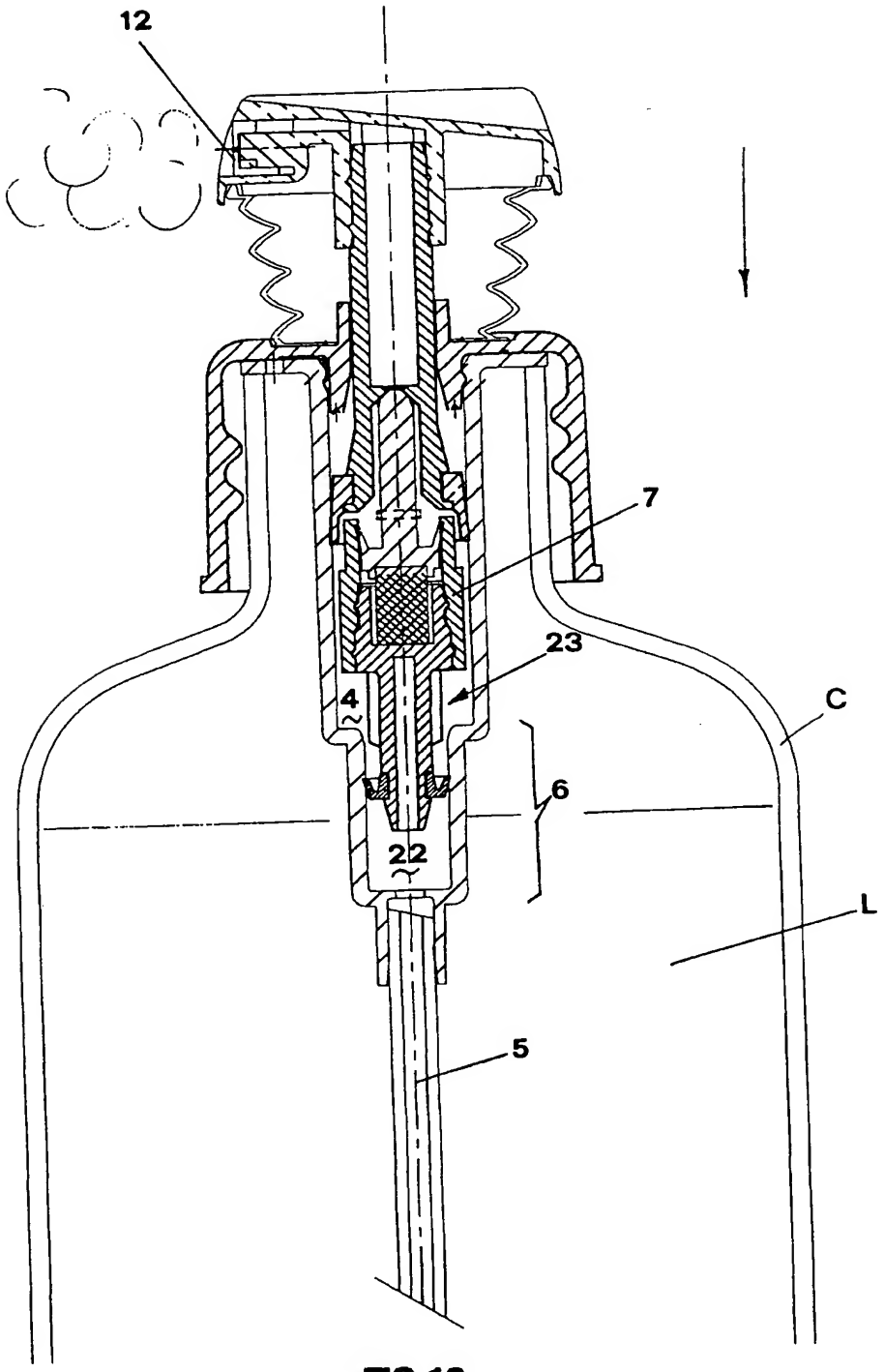

FIG.12

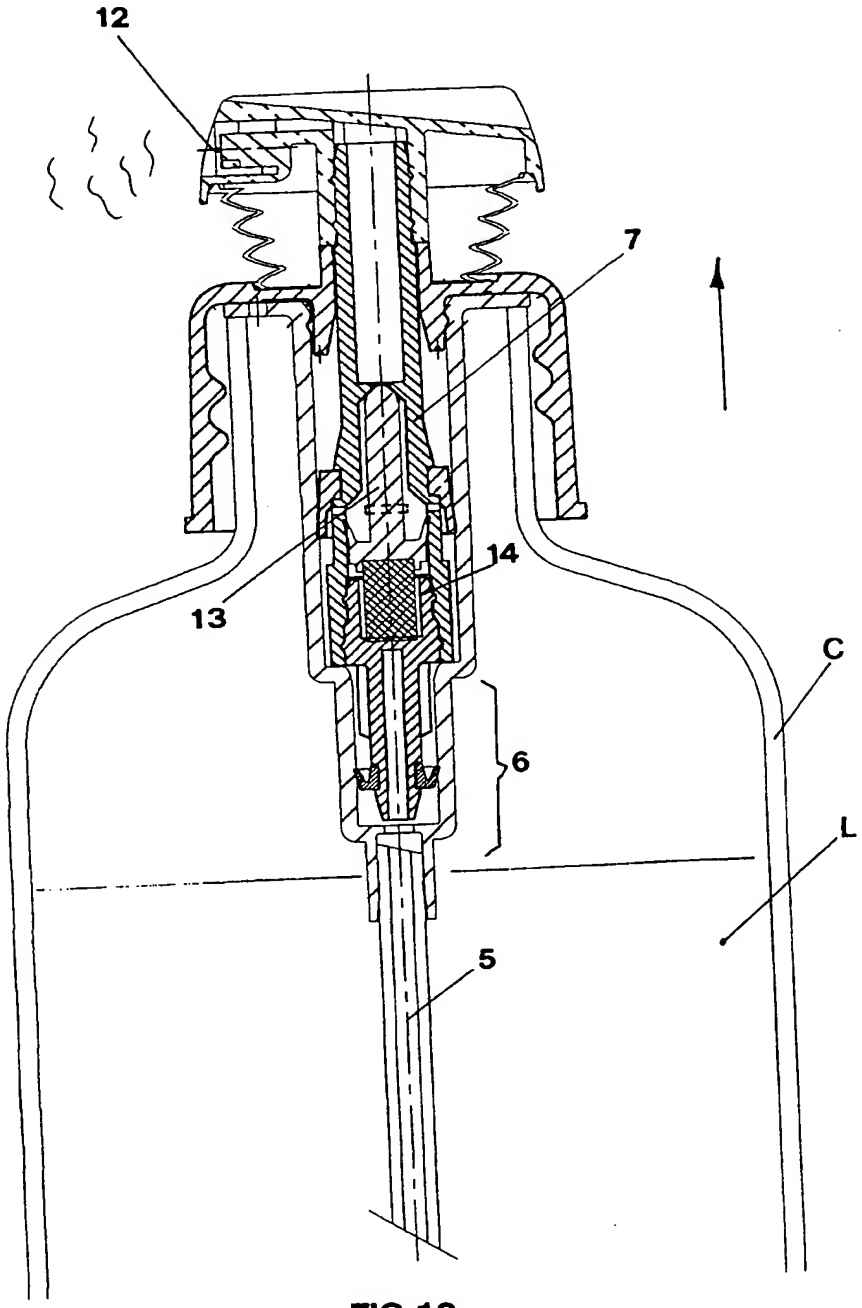

FIG.13

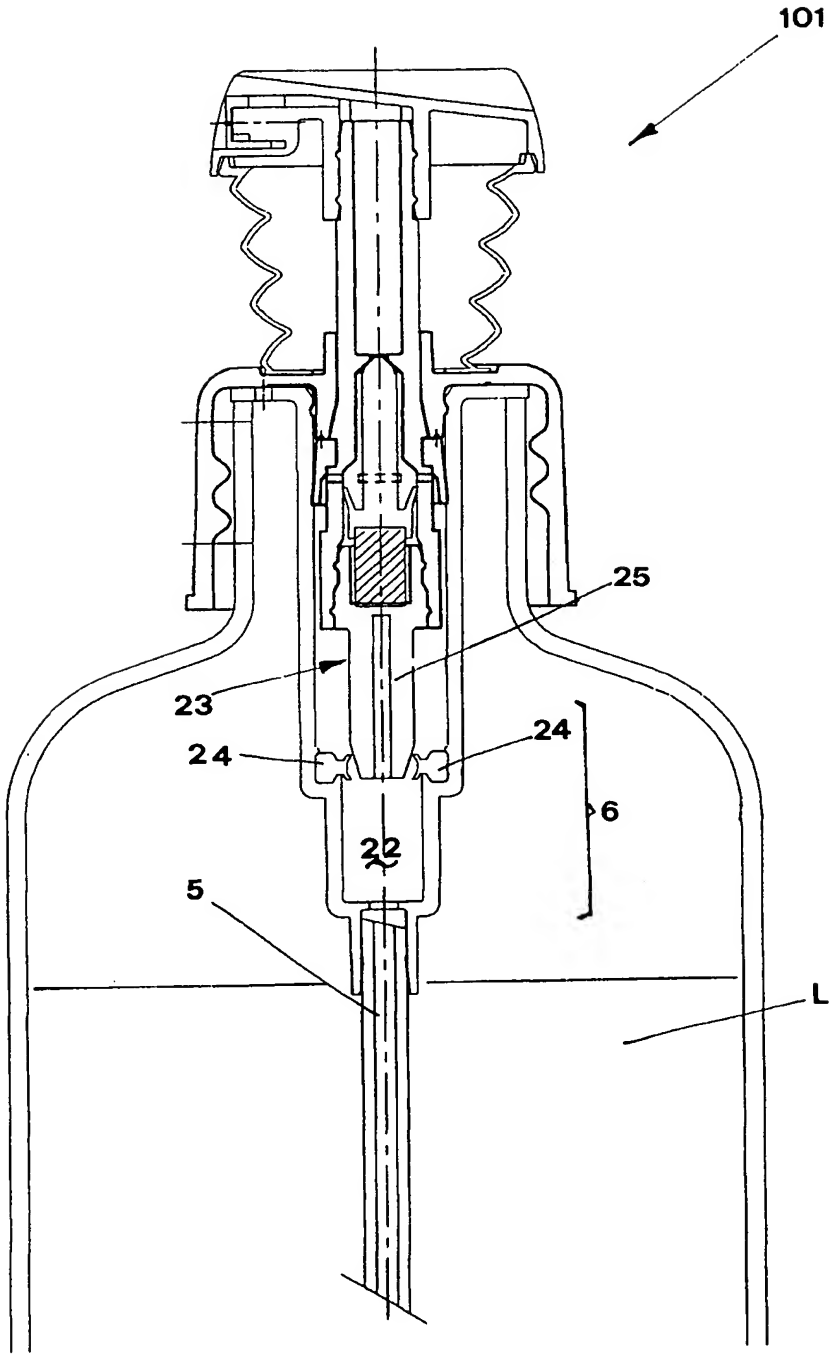

FIG.14

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/EP 00/13211

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B11/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 5 025 958 A (MONTANER PEDRO P ET AL) 25 June 1991 (1991-06-25) column 2, line 57 -column 3, line 18 column 3, line 30-40 column 3, line 56 -column 4, line 9; figure 1 ---	1,2,7,10
Y	EP 0 791 397 A (CAIDEIL M P TEORANTA) 27 August 1997 (1997-08-27) column 5, line 1-6 claim 1; figure 1 ---	1,2,7,10
A	WO 96 28257 A (SANTAGIULIANA EVANS ;TAPLAST SRL (IT)) 19 September 1996 (1996-09-19) page 3, line 13-27; figures 2,4,6 --- -/--	3-6

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
19 March 2001	30/03/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Busto, M

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INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/EP 00/13211

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	DE 43 32 869 A (PERFECT VENTIL GMBH) 6 April 1995 (1995-04-06) column 6, line 31-46; figures 1,5 ---	8,9
A	FR 2 402 088 A (COSTER TECNOLOGIE SPECIALI SPA) 30 March 1979 (1979-03-30) page 2,. line 38 -page 3, line 8; figures 1,3 -----	11,12

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

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Information on patent family members

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